

## PATENT COOPERATION TREATY

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## INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference FP2554/MM	<b>FOR FURTHER ACTION</b>		See Form PCT/IPEA/416
International application No. PCT/SG2005/000063	International filing date (day/month/year) 1 March 2005	Priority date (day/month/year) 4 March 2004	
International Patent Classification (IPC) or national classification and IPC  Int. Cl.  <i>A61B 5/103 (2006.01)</i> <i>A61M 25/00 (2006.01)</i> <i>G01L 1/24 (2006.01)</i> <i>A61B 1/00 (2006.01)</i> <i>G01L 1/10 (2006.01)</i>			
Applicant AGENCY FOR SCIENCE, TECHNOLOGY AND RESEARCH et al			

1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 5 sheets, including this cover sheet.

3. This report is also accompanied by ANNEXES, comprising:

a.  (*sent to the applicant and to the International Bureau*) a total of 4 sheets, as follows:

sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).

sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.

b.  (*sent to the International Bureau only*) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or table related thereto, in electronic form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).

4. This report contains indications relating to the following items:

<input checked="" type="checkbox"/> Box No. I	Basis of the report
<input type="checkbox"/> Box No. II	Priority
<input type="checkbox"/> Box No. III	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
<input type="checkbox"/> Box No. IV	Lack of unity of invention
<input checked="" type="checkbox"/> Box No. V	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
<input checked="" type="checkbox"/> Box No. VI	Certain documents cited
<input type="checkbox"/> Box No. VII	Certain defects in the international application
<input type="checkbox"/> Box No. VIII	Certain observations on the international application

Date of submission of the demand 4 January 2006	Date of completion of this report 24 February 2006
Name and mailing address of the IPEA/AU  AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaaustralia.gov.au Facsimile No. (02) 6285 3929	Authorized Officer   <b>MATTHEW FORWARD</b> Telephone No. (02) 6283 2606

## INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.

PCT/SG2005/000063

## Box No. I Basis of the report

1. With regard to the language, this report is based on:

 The international application in the language in which it was filed A translation of the international application into , which is the language of a translation furnished for the purposes of: international search (under Rules 12.3(a) and 23.1 (b)) publication of the international application (under Rule 12.4(a)) international preliminary examination (Rules 55.2(a) and/or 55.3(a))2. With regard to the elements of the international application, this report is based on (*replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report*): the international application as originally filed/furnished the description:

pages 1,3, 5-29 as originally filed/furnished

pages\* 2, 4 received by this Authority on 4 January 2006 with the letter of 4 January 2006

pages\* received by this Authority on with the letter of

 the claims:

pages as originally filed/furnished

pages\* as amended (together with any statement) under Article 19

pages\* 30, 31 received by this Authority on 4 January 2006 with the letter of 4 January 2006

pages\* received by this Authority on with the letter of

 the drawings:

pages 1/10-10/10 as originally filed/furnished

pages\* received by this Authority on with the letter of

pages\* received by this Authority on with the letter of

 a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing.3.  The amendments have resulted in the cancellation of: the description, pages the claims, Nos. the drawings, sheets/figs the sequence listing (*specify*): any table(s) related to the sequence listing (*specify*):4.  This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)). the description, pages the claims, Nos. the drawings, sheets/figs the sequence listing (*specify*): any table(s) related to the sequence listing (*specify*):

\* If item 4 applies, some or all of those sheets may be marked "superseded."

Box No. V	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
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## 1. Statement

Novelty (N)	Claims 1-10	YES
	Claims	NO
Inventive step (IS)	Claims 1-10	YES
	Claims	NO
Industrial applicability (IA)	Claims 1-10	YES
	Claims	NO

## 2. Citations and explanations (Rule 70.7)

The following documents identified in the International Search Report have been considered for the purposes of this report:

- D1 US 4366810 (SLANTEZ)
- D2 US 4873990 (HOLMES et al)
- D3 JP 6-190050 (MITSUBISHI CABLE IND LTD et al)
- D4 US 5339799 (KAMI et al)
- D5 WO 1997010746 (UNIVERSITY OF WALES COLLEGE OF MEDICINE)
- D6 JP 9-192230 (TOSHIO et al)
- D7 WO 1999033392 (SKRABAL et al)
- D8 US 5957833 (SHAN)
- D9 WO 2002007617 (VERIMETRA, INC.)
- D10 US 6612992 (HOSSACK et al)

Documents D2, D5 to D8 and D10 relate to claims that have been deleted and will not be subject to further consideration.

The following documents were cited as relevant to the subject matter of the present claims.

Document D1 provides an array of pressure sensors disposed about an elongate intervention device. The device is steered by control means in response to the pressure of force being applied to the sensors by a body lumen wall. The sensor array provides a tactile control of the elongate device (column 3 lines 49 to 55). Due to the sensors being on all sides of the device, it will be measuring 3-D forces acting on the device.

Document D3 provides a tactile sensor at the end of an elongate medical device. The sensor allows the force being applied to a vessel to be carefully monitored and prevents the device breaking through the internal wall of the vessel.

In document D4 a medical system includes an elongate device having pressure sensors in the grasping portions that detect the "state of contact" between the tissue and the device. A reproduction mechanism amplifies the signal from the sensors such that the surgeon can perceive the "state of contact".

Document D9 recites a scalpel blade with an integrated strain and pressure gauges. The readings from these gauges are analysed to assist the surgeon and may be compared to a database of known tissue and workplace parameters to identify the type of tissue being cut. In addition the surgeon may obtain direct tactile feedback from an analysis of the strain and pressure gauges.

Continued/ see supplementary sheet.

## INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.

PCT/SG2005/000063

## Box No. VI Certain documents cited

## 1. Certain published documents (Rule 70.10)

Application No. <u>Patent No.</u>	Publication date <u>(day/month/year)</u>	Filing date <u>(day/month/year)</u>	Priority date ( valid claim) <u>(day/month/year)</u>
P,X DE 10303270	5 August 2004	28 January 2003	28 January 2003
P,X WO 2005011511	10 February 2005	19 July 2004	1 August 2003

DE 10303270 discloses a catheter with a force sensor at the distal end. The sensor haptically alters the surgeon when a large force is acting on the catheter. WO 2005011511 recites a catheter or similar elongate device, with a sensor that detects force acting on the catheter. Claims 1 to 10 are novel and inventive in view of these documents.

## 2. Non-written disclosures (Rule 70.9)

Kind of non-written disclosure	Date of non-written disclosure <u>(day/month/year)</u>	Date of written disclosure referring to non-written disclosure <u>(day/month/year)</u>

## Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of: Box V

New Citations

D11 EP 0970661 A2 (MITSUBISHI DENKI KABUSIKI KAISHA) 12 January 2000  
D12 WO 2003/077101 A2 (Z-KAT, INC.) 18 September 2003  
D13 WO 2003/045264 A1 (KONINKLIJKE PHILIPS ELECTRONICS KV) 5 June 2003

Each of these documents includes a haptic feedback system.

D11 is directed to a surgical simulation system wherein the forces being applied to a haptic are sensed and a processor calculates desired forces that are returned to the user as feedback.

D12 feedback is discussed in terms of a program that calculates feedback based on the velocity of the haptic and thus does disclose a feedback apparatus as presently defined.

In D13 tactile feedback is provided based on measured forces experienced by the medical instrument. Feedback is derived from a force signal via a processing unit (800). A feedback apparatus as presently defined is not suggested.

Claims 1 to 10 are considered to be novel, possess an inventive step and have industrial application and therefore satisfy Articles 33(2) to 33(4) of the PCT in view of the cited documents.

It is an object of the invention to provide medical apparatus which can assist the specialist in such a procedure.

5 It is another object of the invention to provide medical apparatus which can be used in a simulation procedure for training of such specialists.

SUMMARY OF THE INVENTION

According to an aspect of the invention, there is provided haptic feedback apparatus comprising force application means arranged to apply a force to an elongate intervention device, control means arranged to control the force applied to the intervention device by the force application means, the control means being connected to at least one sensor arranged to sense a remote force on the intervention device and the control means being arranged to calculate the applied force in accordance with the remote force, the applied force being an amplification of the remote force. The force application means comprises a resilient member arranged to apply the said force to the intervention device. The haptic feedback apparatus further comprises a sensor arranged to detect frictional force between the resilient member and the intervention device. The detected frictional force may then be used to control the amount of applied force.

Preferably, the force application means applies both an axial and a radial force to the catheter.

CLAIMS

1. Haptic feedback apparatus comprising:
  - force application means arranged to apply a force to an elongate intervention device,
  - control means arranged to control the force applied to the intervention device by the force application means, the control means being connected to at least one sensor arranged to sense a remote force on the intervention device and the control means being arranged to calculate the applied force in accordance with the remote force, the applied force being an amplification of the remote force,
  - wherein the force application means comprises a resilient member arranged to apply the said force to the intervention device, and
  - wherein the apparatus further comprises a sensor arranged to detect frictional force between the resilient member and the intervention device.
- 15 2. Haptic feedback apparatus according to claim 1, wherein the detected frictional force is used to control the amount of applied force.
3. Haptic feedback apparatus according to claim 1 or claim 2, further comprising 20 means for tracking the rotational movement of the intervention device.
4. Haptic feedback apparatus according to any one of claims 1 to 3, further comprising means for tracking the linear movement of the intervention device.

5. Haptic feedback apparatus according to any one of claims 1 to 4, further comprising means for comparing the remote force with a reference force.
6. Haptic feedback apparatus according to any one of claims 1 to 5, wherein the 5 intervention device is suitable for insertion into a simulated human model.
7. Haptic feedback apparatus according to claim 6, wherein the remote force is generated using computer simulation.
- 10 8. Haptic feedback apparatus according to any one of claims 1 to 7, wherein the intervention device is operable to be inserted into a human subject.
9. Haptic feedback apparatus according to any one of claims 1 to 8, wherein the at least one sensor is disposed near or at a tip of the intervention device.
- 15 10. Haptic feedback apparatus according to any one of claims 1 to 9, further comprising a plurality of sensors disposed along the length of the intervention device and the control means is connected to each of the plurality of sensors.